

DESCRIPTIONS OF NEW SPECIES OF CRINOIDS,  
CHIEFLY FROM THE COLLECTIONS MADE BY THE  
U. S. FISHERIES STEAMER "ALBATROSS" AT THE  
HAWAIIAN ISLANDS IN 1902; WITH REMARKS ON  
THE CLASSIFICATION OF THE COMATULIDA.

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The present paper relates chiefly to the collections made in 1902 at the Hawaiian Islands by the steamer *Albatross*, of the Bureau of Fisheries, but contains also descriptions of new species obtained elsewhere by the same steamer, and a discussion of the classification of the free crinoids.

Mr. Walter K. Fisher, of Palo Alto, California, who accompanied the *Albatross* on the Hawaiian cruise, made color notes from life of some of the species on the labels. I have made use of these notes, giving due credit to Mr. Fisher.

Although the *Albatross* made 344 dredge hauls, the collection is a small one, containing only 64 specimens, representing 11 species, 7 of which are known only from a single example, and 2 more from only 2. In other words, the entire collection is rather less in individuals and in species than a single haul made by the *Albatross* in 1906 in the Eastern Sea, off Kagoshima Gulf. However, in spite of its small size, it is a collection of very exceptional interest, quite as much through the forms which are lacking as through those included.

No stalked crinoids were found among the Hawaiian Islands, all the forms belonging to the order Comatulida, the Comatulids, or Feather Stars.

The order Comatulida, as at present understood, consists of 11 families, including about 30 recent genera. Two of the families, Thiolliericrinidae and Uintacrinidae, each containing only a single genus representing, respectively, the least and most specialized types of the order, are only known in the fossil state.

## KEY TO THE FAMILIES OF COMATULIDA HAVING RECENT REPRESENTATIVES.

- a.* Large orals present ----- THAUMATOCRINIDÆ.
- a'*. No orals
- b.* Basals present; cirrus sockets bordered anteriorly and laterally by an elevated ridge ----- ATELECRINIDÆ.
- b'*. Basals metamorphosed into a rosette; cirrus sockets with no antero-lateral ridge.
- c.* Arms undivided ----- EUDIOCRINIDÆ.
- c'*. Arms divide at least once.
- d.* Mouth central, anus lateral; oral pinnules with the tips not furnished with a comb.
- c.* Costals articulated.
- f.* Middle and distal pinnules sharply triangular and styliform; central cavity of centro-dorsal very small.
- g.* Muscular fosse on distal face of radials very high, much longer than broad; terminal pinnules very short, not extending beyond tip of arm ----- THALASSOMETRIDÆ.
- g'*. Muscular fosse narrow and transversely linear; terminal pinnules extending far beyond tip of arm ----- TROPIOMETRIDÆ.
- f'*. Middle and distal pinnules round, the articulations swollen; central cavity of centro-dorsal very large.
- g.* Lower pinnules slender, like the following; opposing spine when present terminally situated; some or all of the cirrus joints "dice-box shaped;" muscular fosse on faces of radials meeting in the median line, and separated from the ligament fosse by a strong diagonal ridge ----- ANTEDONIDÆ (restricted).
- g'*. One or more of the lower pinnules enlarged, and much stouter than the succeeding; opposing spine, when present, centrally situated; cirrus joints with more or less convex borders; muscular fosse entirely and widely separated from each other, but not separated by a diagonal ridge from the ligament fosse ----- HIMEROMETRIDÆ.
- c'*. Costals united by syzygy ----- ZYOMETRIDÆ.
- d'*. Mouth marginal, anus central; oral pinnules furnished with a terminal comb ----- COMASTERIDÆ.

This key is, so far as possible, based upon obvious external characters which can be appreciated at a glance; a detailed discussion of the families and their fundamental characters is reserved for a future paper.

The geographical and bathymetrical range of the families is as follows:

THAUMATOCRINIDÆ (based upon a genus and species founded upon a single small, probably immature, individual): southwest of Melbourne, Australia; 1,800 fathoms.

ATELECRINIDÆ (*Atelecrinus*): West Indies; coast of Brazil; Fiji; Hawaiian Islands; 291 to 610 (?809) fathoms.

EUDIOCRINIDÆ (*Eudiocrinus*; *Decametrocrinus*): West Indies; coasts of southern Europe; coasts of Somaliland, and the Crozet Islands, eastward to the Meangis and Hawaiian Islands, northward to Japan; 103 to 1,800 fathoms.

THALASSOMETRIDÆ (*Thalassometra*; *Stylometra*; *Charitometra*; *Pæcilometra*); West Indies and coast of Portugal southward to Cape Colony and the Crozet Islands, eastward to Australia, the Meangis Islands, the Galapagos Islands, Panama, and the Hawaiian Islands, and northward to Japan and the western Aleutian Islands; 52 to 1,600 fathoms.

TROPIOMETRIDÆ (*Tropiometra*; *Ptilometra*; *Asterometra*; *Calometra*); West Indies and coast of Brazil; Madeira south to Cape Colony; Red Sea and east Africa eastward to the South Sea Islands, northward to Japan, and southward to the southern coast of Australia; mainly littoral and sublittoral, but in the Caribbean Sea, extending down to 278 fathoms.

ANTEDONIDÆ, as restricted (*Antedon*; *Thysanometra*; *Coccometra*; *Heliometra*; *Promachocrinus*; *Trichometra*; *Adelometra*; *Psathyrometra*; *Zenometra*; *Hypalometra*; *Isometra*; *Bathymetra*; *Thaumatometra*; *Hathrometra*; *Leptometra*; *Compsometra*; *Iridometra*; *Naiometra*; *Erythrometra*; *Perometra*); practically cosmopolitan; littoral down to 2,900 fathoms.

HIMEROMETRIDÆ (*Oligometra*; *Cyllometra*; *Himerometra*; *Pontiometra*); Caribbean Sea at Panama; East Africa and Madagascar eastward to the Marshall and Society islands, southward to New South Wales and northward to Japan; mainly littoral and sublittoral, but possibly extending down to 255 fathoms.

ZYGOMETRIDÆ (*Zygometra*); northern Australia northward to Japan; sublittoral, and down to 152 fathoms.

COMASTERIDÆ (*Comaster*; *Comatula*); South Carolina and the Bay of Biscay, south to southern Brazil and Cape Colony; east Africa and Madagascar, eastward to the Society Islands and Peru, northward to Japan and southward to southern Australia; mainly littoral and sublittoral, but extending down to 830 fathoms in the Caribbean Sea.

It must be emphasized that the collection undoubtedly represents but a very small fraction of the entire number of species inhabiting the area under consideration, but, on the other hand, it is probable that further investigation will not radically alter the general conclusions.

Crinoids were found only between 136 and 1,000 fathoms, although the investigations were carried on from the exposed reefs down to 2,629 fathoms. The following families were not represented: Thaumacrinidæ, Himerometridæ, Tropiometridæ, Zygometridæ, and Comasteridæ, while representatives of the families Atelecrinidæ, Thalassometridæ, Eudiocrinidæ, and Antedonidæ were secured. This is very significant, for the four families which, by their great abundance in the region from east Africa eastward to Oceania and northward to Japan (to which one of the families and seven of

the ten genera forming the others are exclusively confined), may be considered as peculiarly characteristic of it, are entirely absent; while the four families occurring in the Hawaiian Islands are all of very wide distribution, in the Atlantic as well as the Pacific; moreover, the former are mainly littoral or inhabitants of shallow water, while of the latter three are confined to deep water and the other is cosmopolitan. The Hawaiian erinoids, so far as known, all belong to very wide-ranging types inhabiting fairly deep water. Comparison with other localities is interesting; in the following table are given the genera occurring in the West Indies, Japan, off the Crozet Islands, among the western Aleutian Islands, and in the Galapagos Islands, compared with those of the Hawaiian Islands:

Name.	West Indies.	Japan.	Crozet Islands.	Aleutian Islands.	Galapagos Islands.	Hawaiian Islands.
Atelecrinida:						
<i>Atelecrinus</i> .....						
Endiocrinida:						
<i>Eudiocrinus</i> .....		x				
<i>Decametrocrinus</i> .....		x				
Antedouida:						
<i>Adelometra</i> .....						
<i>Cocometra</i> .....						
<i>Erythrometra</i> .....		x				
<i>Heliometra</i> .....		x				
<i>Hypalometra</i> .....						
<i>Iridometra</i> .....		x				x
<i>Nanometra</i> .....		x				
<i>Perometra</i> .....		x				
<i>Psathyrometra</i> .....		x			x	x
<i>Thysanometra</i> .....		x				
<i>Thaumatometra</i> .....		x		x	x	
<i>Trichometra</i> .....	x	x				x
<i>Zenometra</i> .....	x					x
Thalassometrida:						
<i>Charitometra</i> .....	x	x				x
<i>Precilometra</i> .....		x				
<i>Thalassometra</i> .....		x	x	x	x	x
<i>Stylometra</i> .....		x				
Tropiometrida:						
<i>Tropiometra</i> .....		x				
<i>Astrometra</i> .....		x				
<i>Calometra</i> .....		x				
Himerometrida:						
<i>Oligometra</i> .....		x				
<i>Cylometra</i> .....		x				
<i>Himerometra</i> .....		x				
Zygometrina:						
<i>Zygometra</i> .....		x				
Comasterida:						
<i>Comaster</i> .....		x				
<i>Comatula</i> .....		x				

It will be observed, then, that of the 8 genera represented in the Hawaiian Islands, 2 occur in the Aleutian and Galapagos Islands; 2 occur in the Crozet Islands; 5 occur in Japan; 4 occur in the West Indies, only one of which occurs in Japan, two of them being known from only the West Indies and the Hawaiian Islands.

The Hawaiian fauna, as at present known, comprises two West Indian genera (*Zenometra*; *Trichometra*), one East Indian-Japanese genus (*Iridometra*), one South Seas-Indo-Pacific genus (*Decame-*

*trocrinus*), one North Pacific genus (*Psathyrometra*), and three genera (*Atelectrinus*; *Thalassometra*; *Charitometra*) of exceedingly wide distribution; of the six species belonging to the three last, four are of a generalized type, while two, *Thalassometra fisheri* and *Charitometra lateralis* show Indo-Japanese affinities. In other words, it is *tropical oceanic*; that is, composed of genera which are certain to be found in *all* tropical or subtropical isolated islands, with a slight West Indian and somewhat stronger Indo-Japanese tinge. As might be expected from the isolated condition of the islands, and the great distance separating them from any locality of which we have a clear idea of the crinoid fauna, all the species are new; but, rather oddly, there are no new genera.

It is perhaps well to call attention to the fact that species have been recorded from the Hawaiian Islands, and specimens exist in collections so labeled, belonging to the Comasteridae and Himerometridae; these have probably been brought as curios to Honolulu from Japan or Samoa and then sold as having been obtained in the Hawaiian Islands; did these families really occur, I am sure they would not have escaped such energetic collectors as the scientific staff of the *Albatross*.

KEY TO THE CRINOIDS OF THE HAWAIIAN ISLANDS.<sup>a</sup>

- a. Basals present, forming a narrow band between the radials and the long conical centro-dorsal; no pinnules on the lowest 12 brachials.  
*Atelectrinus conifer*.
- a'. Radials resting directly upon the centro-dorsal; the second brachial, and all following, bear pinnules.
- b. Nine radials, giving rise to nine undivided arms—*Decametrocrinus rugosus*.
- b'. Five radials, giving rise to arms which divide at least once.
- c. Ambulacra of arms and pinnules naked.
- d. Centro-dorsal low, the cirri without definite arrangement; yellow or brownish; small.
- e. 25–45 cirrus joints; first pinnule greatly elongated and extremely slender—*Trichometra vexator*.
- e'. 10 or 12 cirrus joints; first pinnule only slightly longer than the second—*Iridometra crispa*.
- d'. Centro-dorsal long and conical, the cirri in definite columns; red or purple.
- e. Cirri in 15 columns; calyx spiny; proximal cirrus joints elongated, distal short and spiny—*Zenometra triserialis*.
- e'. Cirri in 20 columns; calyx smooth; all the cirrus joints greatly elongated, the distal without spines—*Psathyrometra congesta*.
- c'. Ambulacra of arms and pinnules protected by large covering-plates.
- d. First pinnule larger and stouter than its successors; genital pinnules not expanded; distal cirrus joints very short and spiny.

<sup>a</sup>This key is not adapted to any but Hawaiian species.

- e. Calyx and arm bases very spiny; distichals 4 (3+4).  
 f. First pinnule enormously enlarged with 12 joints; 10 to 12 arms up to 110 mm. in length; palmars not present; spines on cirri sharp-----*Thalassometra hawaiiensis*.  
 f'. First pinnule not especially enlarged, with 22 joints; 17 arms 180 mm. in length; palmars present; blunt spines on cirri.  
*Thalassometra gigantea*.  
 e'. Calyx and arm bases smooth; distichals 2.  
 f. Less than 30 cirrus joints-----*Thalassometra fisheri*.  
 f'. More than 30 cirrus joints.  
 g. Palmars absent; cirri stout with 55-60 joints.  
*Thalassometra crassicirra*.  
 g'. Palmars present on outer side of rays; cirri slender with 40 joints-----*Thalassometra delicata*.  
 d'. First two pinnules more slender than their successors with more numerous and smaller joints; genital pinnules expanded; all the cirrus joints elongated, without dorsal spines--*Charitometra lateralis*.

## Order COMATULIDA.

### Family ATELECRINIDÆ.

#### Genus ATELECRINUS.

##### ATELECRINUS CONIFER, new species.

Centro-dorsal conical, the sides but slightly convex, 5 mm. broad at the base and 6 mm. long, bearing 15 columns (5 triple columns) of cirrus sockets, about 5 to a column, the cirrus sockets being similar in character to those of the other species of the genus.

Cirri broken; the longest stump, which measures 35 mm., consists of 19 joints, of which the first 2 are short, the third about half again as long as wide, and the remainder about three times as long as wide; the joints do not overlap.

Basals very narrow, forming a uniform narrow band between the radials and the centro-dorsal, not prominent interradially; the proximal edge of the centro-dorsal is somewhat prominent in the angles of the calyx; radials somewhat over twice as broad as long, closely united laterally, the dorsal surface almost flat, the anterior edge straight, the posterior convex; first costal not quite so long as broad, oblong, slightly incised anteriorly, the dorsal surface moderately curved; costal axillaries about as long as broad, nearly square, the sides slightly concave; the brachials are similar to those in *Atelecrinus balanoides*, but are proportionately stouter; the junctions between the costals and the first two brachials are more tubercular than in the other species.

The longest arm is broken off at the twelfth brachial. The specimen has no pinnules.

The entire length of the specimen, from the tip of the centro-dorsal to the twelfth brachial, is 25 mm.

*Color* (in spirits).—Dull yellowish white; probably yellow in life.

*Locality*.—*Albatross Station No. 3887*; Mokuhooniki Islet bearing S. 15° W. 8.8 miles distant (north coast of Molokai); 552–809 fathoms; globigerina mud.

One specimen, much mutilated.

*Type*.—Cat. No. 22685, U.S.N.M.

*Remarks*.—*Atelecrinus conifer* is at once distinguishable from the three other species of the genus by having three instead of two columns of cirrus sockets in each radial area on the centro-dorsal. It lacks the peculiar groove between the basals and the centro-dorsal which is found in the other Pacific species, and is much the largest species yet discovered.

*Atelecrinus* was first discovered off Cojima, near Habana, Cuba, and later at many points in the Caribbean Sea, and off the Brazilian coast, southeast of Pernambuco; later the *Challenger* discovered it in the south Pacific near Fiji. The discovery of a species in the Hawaiian Islands, therefore, greatly increases its known geographic range.

### Family EUDIOCRINIDÆ.

#### Genus DECAMETROCRINUS.

#### DECAMETROCRINUS RUGOSUS, new species.

Centro-dorsal very low, hemispherical, bearing about 90 closely crowded cirri; a rather large bare polar area, the surface thickly studded with shallow pits.

Cirri broken off at the base; the longest fragment is 15 mm. long with 7 joints, the first very short, the second about as long as broad, the third about three times as long as broad, and the remainder about four times as long as broad; the first two joints are practically round in cross-section, the third and following becoming laterally compressed; the joints are oblong with the distal ends nearly straight.

Nine rays, each with an undivided arm; radials even with the edge of the centro-dorsal; first brachials about twice as broad as long, closely united in their posterior half, but widely free anteriorly, leaving a large U-shaped gap extending down between the anterior halves of adjacent first brachials; second brachial trapezoidal, half again as broad anteriorly as posteriorly, the sides concave; second brachial nearly twice as broad as long, the anterior and posterior edges equal to the anterior edge of the first brachial in length, the lateral edges strongly concave; the long axis of its posterior face is at right angles to the median plane of the arm, but the long axis of its anterior face is turned nearly 45°; the fourth and fifth brachials constitute the first syzygial pair, which is about as long as its greatest diameter, and strongly concave laterally; the long axes of its anterior and

posterior faces are almost at right angles, the opposed syzygial faces being practically round; next four joints similar to the second brachial; the joints from the second to the ninth brachial are rather disproportionately large, and very strongly tubercular; the following joints are wedge-shaped, smooth, nearly twice as broad as long, soon becoming rather more obliquely wedge-shaped, or practically triangular, about as long as broad, and distally wedge-shaped again and much longer than broad, as much as four or five times as long as broad on the terminal joints. The arms appear to have been between 200 mm. and 250 mm. long. Syzygia occur between the fourth and fifth brachials, again between the ninth and tenth, and then at intervals of two to four (usually three or four) bifascial articulations.

The first pinnule is on the second brachial; the genital pinnules have short round genital glands.

*Locality*.—*Albatross Station No. 4157*: center of Bird Island bearing S. 77° 30' E.; 11.1 miles distance; 762–1,000 fathoms; white mud, foraminifera, and rocks.

One specimen, badly broken.

*Type*.—Cat. No. 22682, U.S.N.M.

*Remarks*.—*Decametrocrinus rugosus* is readily distinguishable from the other species of the genus by its large size and swollen and strongly tubercular lower brachials, as well as by its low centro-dorsal bearing a very large number of cirri, and having a large bare polar area.

The genus *Decametrocrinus* appears to be of very general occurrence in the Pacific and Southern oceans: first discovered by the *Challenger* near the Crozet Islands, it was again taken southwest of Melbourne, Victoria, and later in the Meangis Islands, northeast of New Zealand. The specimens from the two first localities were referred by Doctor Carpenter to the same species, *abyssorum*, while those from the last were considered to be distinct, and were called *naresi*. In 1906 the *Albatross* dredged a fine species off southwestern Japan which was described in the following year under the name of *borealis*. In depth, *abyssorum* ranges from 1,600 to 1,800 fathoms, *naresi* was found at 500 fathoms, and *borealis* at 361 fathoms, while *rugosus* was dredged somewhere between 762 and 1,000 fathoms, the bottom having receded during the haul.

It is of course impossible to tell whether the 9-rayed character of the type of this species is constant, although externally no difference whatever is visible between the various rays. Doctor Carpenter has shown in the case of *Decametrocrinus abyssorum* that the species is 10-rayed from the radials outward, the basal star being 5-rayed as usual, thus suggesting that in the present specimen one of the rays has been omitted; it is necessary to be cautious, however, and not accept that conclusion hastily, in view of the recent discovery of a



more or less normal multiradiate condition in *Tropiometra carinata*. It may be that the 9-rayed condition arises from a departure from the usual pentamerous type which affects the entire animal, and not from a mere doubling of the rays.

It is well to here call attention to the fact that *Promachocrinus* and *Decametrocrinus* are not nearly related as supposed by Carpenter and Minckert; the former belongs to the Antedonidæ and is near to *Helioetra*, while the latter belongs to the Eudiocrinidæ and is related to *Eudiocrinus*.

### Family ANTEDONIDÆ.

#### Genus TRICHOMETRA.

##### TRICHOMETRA VEXATOR, new species.

Centro-dorsal subconical, about twice as broad as high, bearing 40 to 60 cirri, closely crowded together and without definite arrangement; there is a moderately large bare polar area.

Cirri about 20 mm. long with 40 to 45 joints on the proximal part of the centro-dorsal, those near the apex being about half as long with 25 to 30 joints; first cirrus joint short, second squarish, third and fourth about half again as long as broad, fifth and following to about the fifteenth about twice as long as broad after which they decrease gradually in length, the last 15 or 20 being squarish; the distal end of the elongate proximal joints project slightly on the dorsal side, and the dorsal side of the shorter distal joints is rather strongly convex, but true dorsal spines are not developed; the opposing spine is prominent and sharp, terminally situated, triangular, in length about equal to the diameter of the penultimate joint.

Radials concealed; first costals short and broad, the lateral edges produced and in apposition, the anterior border strongly concave in the median line; costal axillaries about as broad as long, all the sides somewhat concave, with a rounded posterior border, incising the first costal. Ten arms 60 mm. to 65 mm. long; first brachials short, concave anteriorly, united interiorly in their posterior half; second brachials larger, triangular; third and fourth brachials (syzygial pair) about as long as wide, rather longer interiorly than exteriorly, the hypozygial being somewhat wedge-shaped; following six brachials oblong, broader than long, then becoming triangular about as long as broad, and elongate and somewhat swollen distally. Syzygia occur between the third and fourth brachials, again between the ninth and tenth, and distally at intervals of two bifascial articulations.

The lower pinnules are badly broken in all the specimens; the first pinnule and the pinnule on the fourth (i. e., "third") brachial are exceedingly slender, greatly elongated, with all but a few of the basal joints extremely elongated; the following pinnules are much shorter,

the third and following bearing genital glands; the second pinnule has much elongated joints, but those of the third and following pinnules are not especially long.

*Color* (in spirits).—White; yellow in life (Fisher).

*Localities*.—*Albatross Station No. 3859*.—Mokuhooniki Islet bearing N.  $18^{\circ}$  E. 5.6 miles distant (Pailolo channel, between Molokai and Maui); 138–140 fathoms; fine sand and mud.

Arm fragments.

*Station No. 3865*.—Mokuhooniki Islet bearing S.  $79^{\circ}$  W. 6.9 miles distant (same locality); 256–283 fathoms; fine volcanic sand and rock.

Twenty-one specimens.

*Station No. 3883*.—Mokuhooniki Islet bearing S.  $80^{\circ} 30'$  W. 7.8 miles distant (same locality); 277–284 fathoms; globigerina ooze.

Ten specimens.

*Station No. 3910*.—Diamond Head Light bearing N.  $7^{\circ}$  E. 12.5 miles distant (south coast of Oahu, near Honolulu); 311–337 fathoms; fine gray sand and mud.

Five specimens.

*Station No. 3925*.—Diamond Head Light bearing N.  $29^{\circ} 30'$  E. 10.2 miles distant; 323–299 fathoms; fine gray sand, mud, and rocks.

Two specimens.

*Type*.—Cat. No. 22691, U.S.N.M., from this station.

*Station No. 4105*.—Lae-o Ka Laau Light, Molokai Island, bearing S.  $45^{\circ} 30'$  E. 10.6 miles distant; 314–355 fathoms; fine coral sand and foraminifera.

Six specimens.

*Remarks*.—This species is very similar in general appearance to *T. aspera* of the coast of Florida, but it may be at once distinguished by the lack of the everted and spinous ends of the brachials from which *T. aspera* gets its name.

#### Genus IRIDOMETRA.

##### IRIDOMETRA CRISPA, new species.

Centro-dorsal hemispherical, bearing about 70 cirri without definite arrangement.

Cirri 4 mm. long with 10 to 12 joints, the first short, the remainder longer than broad, the third, fourth and fifth being the longest; the opposing spine is represented by a small tubercle.

Radials almost concealed; first costals short, narrowing rapidly anteriorly, and very deeply incised in the median line; they are rounded dorsally and widely separated; costal axillaries about as long as broad, all the sides concave, much produced posteriorly. Ten arms about 30 mm. long, resembling those of other species of the genus, as *I. parvicirra* or *I. minuta*.

First pinnule 6 mm. long with 12 or 13 joints, the first squarish, the second about twice as long as broad, the third about three times as long as broad, and the following becoming rather more elongated; second pinnule 4.5 mm. long, similar to the first and with the same number of slightly shorter joints; the third and following pinnules are shorter still and slightly stouter, with the distal edges of their component joints everted and serrate and bear genital glands; distally the pinnules become very slender and increase somewhat in length.

*Color* (in spirits).—Yellowish brown, the pinnules and cirri white, the interambulacal areas of the disk also white.

*Locality*.—*Albatross Station No. 3938*; Laysan Island Light bearing S. 88° 30' E. 7.8 miles distant; 148–163 fathoms; white sand and broken shell.

One specimen.

*Type*.—Cat. No. 22692, U.S.N.M.

*Remarks*.—*Iridometra crispa* agrees with *I. serrata* in having the lower pinnules elongate and the first longer than the second, but it differs strikingly in lacking altogether the enormous eversion and overlap of the pinnule joints of that species; the cirrus joints, also, which in *I. serrata* are strongly "dice-box shaped" are practically cylindrical or oblong in *I. crispa*.

#### Genus ZENOMETRA.

##### ZENOMETRA TRISERIALIS, new species.

Centro-dorsal elongate-conical, 6 mm. long by 3 mm. broad at the base, divided into 5 radial areas by interradiial lines, which are not raised above the general area of the centro-dorsal; these lines are at first rather less in width than the diameter of the cirrus sockets, and become obsolete in the distal third of the centro-dorsal, which is thickly set with short spines; each radial area contains three crowded columns of cirrus sockets, usually five to a column.

Cirri about 75 in number, slender, 40 mm. to 45 mm. long, with 60 joints; first joint short; second rather longer; third about as long as broad; following joints becoming gradually longer to about the seventh, which is between two and one-half and three times as long as broad, then remaining uniform until about the eighteenth or twentieth, when they gradually decrease in length, becoming squarish about the thirty-third, and distally broader than long; the fourth or fifth to the eighth or ninth joints have their ends somewhat expanded, and the following have the distal dorsal edge rather prominent, giving the cirri a serrate dorsal and smooth ventral outline in profile; in the terminal portion the cirri become moderately compressed, and the dorsal surface of the joints becomes carinate and forms low

spines; the opposing spine is terminally situated, triangular, about equal in height to the diameter of the penultimate joint, and arising from the entire dorsal surface of that joint; the terminal claw is stout basally, slender distally, strongly curved, and longer than the penultimate joint; both the opposing spine and the terminal claw are rather disproportionately large.

A deep cleft is present between the proximal part of the centro-dorsal and the radials: ends of the basal rays visible, bridging over this cleft interradially. Radials short, the anterior edge fringed with spines; first costal short, about four times as broad as long, incised in the median line by a backward projection from the costal axillary, and with the posterior edge strongly everted and very spinous; costal axillaries rhombic, about twice as broad as long, the edges everted and very spinous. Ten deep, compressed arms, apparently about 150 mm. long; first brachial short, concave anteriorly, rather longer outwardly than inwardly where they are united in their proximal half above the angle of the costal axillary; the posterior border everted and spinous; second brachial larger, irregularly quadrate, the anterior and posterior borders everted and spinous; third and fourth brachials (syzygial pair) about as long as broad, slightly longer inwardly than outwardly, the anterior and posterior edge and the syzygial line spinous; following five joints oblong, about half again as broad as long, with both edges everted and standing up vertically as a row of fine thickly set spines; the following joints are quadrate, about as long as broad, gradually becoming more elongate distally, at the extreme arm tips being oblong, and twice as long as broad; all the joints have overlapping spinous ends. Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of two to five (usually three or four) bifascial articulations.

First pinnule 7 mm. long, very slender, the first four or five joints about as long as broad, broader than the others, the remainder filiform and elongated; second pinnule 10 mm. long, somewhat stouter than the first pinnule, the first two joints comparatively broad, and about as long as broad, the remainder elongate and slender; the following pinnules are very slightly stouter and of decreasing length, then becoming longer again and slightly more slender distally; all the pinnule joints have slightly overlapping, finely spinous edges; the distal pinnules have their two proximal joints considerably expanded, the first joint short and crescentic, the second about as long as its proximal diameter and trapezoidal, the remainder about three times as long as broad.

*Color* (in life).—A deep purplish vinaceous, the calyx and arm bases brownish (Fisher).

*Locality.*—Albatross Station No. 4122; Barber's Point Light (near Honolulu) bearing N. 82° E., 2.2 miles distant; 192–352 fathoms; coarse coral sand and shell.

One specimen.

*Type.*—Cat. No. 22682, U.S.N.M.

*Remarks.*—It was a great surprise to find the genus *Zenometra* represented in the Hawaiian Islands, as the two species with which I was previously acquainted are only known from the West Indies and the Atlantic coast off Florida and southern Georgia; moreover, the Hawaiian species differs markedly from the other two in having the cirri in three instead of two columns in each radial area of the centro-dorsal, thus necessitating a change in the generic diagnosis, while the "wall-sided" character of the costals and lower brachials is much less marked, and the characteristic interradiial ridges on the centro-dorsal are obsolete. These differences appear at first sight to suggest that *Zenometra* is really much nearer *Psathyrometra* than was previously supposed; but the very characteristic cirri with much elongate joints in the proximal part, and very short and spiny joints in the distal, the spiny character of the calyx and arm bases, and the elongate conical-columnar centro-dorsal are even more marked in *Z. triserialis* than in *Z. columnaris* and *Z. pyramidalis*, and show that the two genera are perfectly distinct, though their differential characters are somewhat different from those originally outlined.

#### Genus PSATHYROMETRA.

##### PSATHYROMETRA CONGESTA, new species.

Centro-dorsal conical, the tip rounded, 5 mm. broad and 5 mm. long, with 20 crowded columns of cirrus sockets, 5 to a column, 4 columns to each radial area; the columns in each radial area are not separated in any way from those in adjacent areas. Cirri lacking.

Ends of basal rays prominent, forming an elongate interradiial tubercle, which at its distal end separates the two topmost cirrus sockets of the adjoining radial areas; a deep cleft is present between the proximal end of the centro-dorsal and the dorsal surface of the radials, bridged over interradially by the ends of the basal rays; radials visible as a small triangle over the anterior end of the tubercle representing the extremity of the basal ray; first costal short, narrowing anteriorly, deeply incised in the median line by a strong median backward prolongation of the costal axillary; the first costals are rounded and very widely separated; costal axillaries rhombic, longer than broad, the anterior angle approximately a right angle, the posterior angle acute, the two posterior sides somewhat strongly concave; a fairly sharp high median keel occupies the posterior two-thirds of the joint. Ten arms; first brachial short, longer outwardly

than inwardly, very sharply incised by an angular posterior prolongation from the second brachial, and inwardly united for their anterior half, their free inward sides forming a straight line which is at right angles to their apposed edges; second brachial triangular, somewhat longer than broad; following brachials at first slightly wedge-shaped, broader than long, soon becoming triangular, as long as broad, and quadrate again and finally elongate distally; the distal edges of the joints project very slightly, making the arms somewhat rough. Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of three bifascial articulations.

*Color* (in spirits).—Light purplish brown.

*Locality*.—*Albatross Station No. 3992*; Mokuaee Islet bearing S. 54° E., 3.5 miles distant; 400–500 fathoms; fine gray sand and mud.

One specimen, much mutilated.

*Type*.—Cat. No. 22684, U.S.N.M.

*Remarks*.—The four closely crowded columns of cirrus sockets in each radial area on the centro-dorsal distinguish this species at once from all the others of the genus; it is possibly nearest to *P. bigradata*, which also has four columns of cirrus sockets in each radial area, but in *P. bigradata* they are very small and widely separated, and the radial areas are strongly marked off, while in *P. congesta* they are very large, and the division lines separating the radial areas are obsolete.

## Family THALASSOMETRIDÆ

### Genus THALASSOMETRA.

#### THALASSOMETRA HAWAIIENSIS (A. H. Clark).

1907. *Antedon hawaiiensis* A. H. CLARK, Proc. U. S. Nat. Mus. XXXIII, p. 152.

This species was not obtained by the *Albatross* in 1902, but has previously been taken among the Hawaiian Islands at the following localities:

*Albatross Station No. 3475*.—Kaiwi Channel, southeast of Honolulu; 351 fathoms; fine white sand; December 6, 1891.

*Type*.—Cat. No. 22653, U.S.N.M., from this station.

*Albatross Station No. 3476*.—Same locality; 298 fathoms; fine white sand; December 6, 1891.

#### THALASSOMETRA GIGANTEA, new species.

Centro-dorsal large, conical, the apex blunt, divided by 5 inter-radial ridges into 5 radial areas, each with 2 columns of cirrus sockets, which are more widely separated from each other than from those of adjoining radial areas.

About 30 cirri 60 mm. to 80 mm. long, stout, with 55 to 60 joints, the first 4 short, the fifth squarish, the sixth and seventh about half

again as long as wide, the eighth twice as long as wide, the ninth and tenth about half again as long as wide, the following squarish, gradually becoming shorter distally; the joints up to, and including most of, the eighth, are dull and rather rounded in cross-section; the distal portion of the eighth and the remaining joints are polished and more compressed; from the twelfth or thirteenth onward dorsal spines are developed.

Ends of basal rays visible as a bunch of branching spines in the angles of the calyx; radials even with the edge of the centro-dorsal; first costals very short; costal axillaries rhombic, over twice as broad as long; distichals 4 (3+4), rarely 2 (in the type five times the former, once the latter); palmars (when present) 2, developed on the inside of the arms (1, 2, 2, 1). Seventeen arms (in the type) 180 mm. long; first 10 brachials oblong, about twice as broad as long, then becoming triangular, about as long as broad, distally becoming quadrate and more elongate. The costals and oblong lower brachials have everted edges armed with numerous spines; the following brachials have the edges everted, but more bluntly spinous; the distal brachials have overlapping and spinous distal edges; the axillaries and second distichals (whether axillaries or not) and the second brachials bear a sharp median keel, which is absent from all the other joints.

The first pinnule (and distichal pinnule when present) is 18 mm. long, stout (but not so stout as in *T. hawaiiensis*), with 22 joints, all of which are much broader than long and strongly carinate; the second pinnule is 10 mm. long and much more slender, the third and following 8 mm. long; the distal pinnules reach a length of 27 mm.

*Color* (in life).—Cirri light chrome yellow; arms light chocolate (Fisher).

*Locality*.—*Albatross Station No. 3985*; Hanamaulu warehouse (Kauai) bearing S. 53° 30' W., 6 miles distant; 477–430 fathoms; gray sand, foraminifera, and shore deposit.

One specimen.

*Type*.—Cat. No. 22687. U.S.N.M.

*Remarks*.—The very large size, comparatively slender first pinnule with relatively numerous joints, and the presence of palmars, as well as the remarkable proportionate stoutness of the cirri, distinguish this species from the small 10 to 12 armed *T. hawaiiensis*, in which the first pinnule is exceedingly stout, with only 12 joints.

THALASSOMETRA FISHERI, new species.

Centro-dorsal hemispherical, rather small, the cirrus sockets in 10 columns, 2 in each radial area, and 2 to a column.

Cirri 20 mm. long with 20 to 27 joints (most commonly 25 to 27), the first very short, the next two progressively longer, the fourth

squarish, the fifth half as long again to twice as long as broad, smaller distally than proximally, the terminal quarter with a polished surface like the succeeding, the proximal three-quarters with a dull surface like the preceding joints; this joint has a blunt spine on its dorsal distal edge; sixth joint about half again as long as wide, eighth squarish, the following remaining practically uniform; the sixth and following joints bear sharp dorsal spines.

Radials concealed; first costals short, about three times as broad as long, with a rounded median tubercle; costal axillaries almost low-triangular, about twice as broad as long, the center strongly convex; distichals 2 similar to the costals. Thirteen arms (in the type) 120 mm. long; first and second brachials oblong, about twice as wide as long, the former united interiorly for about two-thirds of their length; third and fourth brachials (syzygial pair) about as long as wide, the hypozygial much larger than the epizygial; following eight brachials slightly wedge-shaped, broader than long, then becoming more obliquely wedge-shaped or almost triangular, about as long as wide, and distally quadrate again and finally elongate. Syzygia occur between the third and fourth brachials, again between the thirteenth and fourteenth to fifteenth and sixteenth (more commonly the former) and distally at intervals of three to seven (most commonly four) bifascial articulations. The costals, distichals, and lower brachials are in close apposition and flattened laterally.

First pinnule 7 mm. long with 15 or 16 joints, the first 3 to 5 large and strongly carinate, about as long as wide or somewhat wider than long, the remainder more slender and slightly longer than wide; second pinnule shorter, somewhat less stout at the base, and tapering evenly, to the tip, the lower joints not being disproportionately large, though they are somewhat carinate; third and fourth pinnule like second, but progressively shorter; the fourth and following pinnules are 5 mm. long with about 12 joints, slightly longer than broad, flattened and markedly carinate, the distal angles of each joint overlapping the base of the next succeeding, producing a strongly serrate lateral outline; the joints are all subequal in size, so that the pinnules appear generally stouter, though smaller, than those preceding; these gradually become longer, reaching 9 mm. distally, but preserve their thin, flattened character, and the serrate appearance of the lateral edges.

*Color* (in life).—Arms cadmium orange, darkest on pinnules; cirri bright lemon yellow (Fisher).

*Locality*.—*Albatross Station No. 4122*; Barber's Point Light (near Honolulu) bearing N. 82° E., 2.2 miles distant; 192–352 fathoms; coarse coral sand and shell.

One specimen.

*Type*.—Cat. No. 22686, U.S.N.M.



*Remarks.*—This species is related to *Thalassometra compressa* of the Philippines and *T. orion* of southern Japan, but is at once distinguished by the prominent dorsal spines on the cirri, the greater number of cirrus-joints, and the greater proportionate length of the cirri, and the flatness and strong carination of the middle and distal pinnules.

In the lists of species belonging to the two genera published when I established *Thalassometra* and *Charitometra*, *orion* and *compressa* were erroneously assigned to the latter. *Porrecta* and *flava*, of whose position I was at the time uncertain, also belong to *Thalassometra*.

I take great pleasure in associating with this interesting species the name of my friend Mr. Walter K. Fisher, of Stanford University, California.

THALASSOMETRA CRASSICIRRA, new species.

This species in its general appearance and proportions resembles *T. gigantea*; but it differs in having exactly 20 arms, all the distichals being 2, and in having the costals, distichals, and first 7 brachials perfectly smooth, without spines, in close apposition and sharply "wall-sided." The cirri are stout, and resemble those of *T. gigantea*, having approximately the same number of joints. The arms are about 120 mm. long.

*Color* (in spirits).—Light orange brown, the costals, distichals, and first four brachials dark brown.

*Localities.*—*Albatross Station No. 3882*; Mokuhooniki Islet bearing N. 30° W., 3.1 miles distant (Pailolo channel, between Maui and Molokai); 136 fathoms; sand, coral, and rock.

One specimen.

*Type.*—Cat. No. 22689, U.S.N.M., from this station.

*Station No. 4107.*—Lae-o Ka Laau Light, Molokai Island, bearing S. 34° 30' E., 12.3 miles distant; 350–355 fathoms; coral, sand, and foraminifera.

One small ten-armed specimen.

*Remarks.*—The absence of palmars and the stout cirri with a comparatively large number of joints distinguish this form from the only other "bidistichate" species of the genus occurring in the Hawaiian Islands.

THALASSOMETRA DELICATA, new species.

Centro-dorsal small, conical, bearing 10 columns of cirrus sockets, 2 to a column, the 2 columns in each radial area separated by a more or less pronounced radial ridge.

Cirri 25 mm. to 30 mm. long of about 40 joints, the first 3 short, the fourth squarish, the following to the sixteenth about half again as long as wide, perfectly smooth, the surface dull; remaining joints

highly polished, at first squarish, then gradually becoming short; all the short and polished joints are furnished with sharp dorsal spines.

Ends of basal rays visible as small tubercles in the angles of the calyx; radials concealed; first costals very short, with the edges somewhat raised, and a pronounced median tubercle; costal axillaries rhombic, over twice as broad as long, the edges somewhat raised, and with a rounded median keel; distichals and palmars 2, similar to the costals, but with the edges not so prominent; the latter occurring 2, 1, 1, 2. Twenty-eight arms (in the type) 100 mm. long; lower brachials discoidal, gradually becoming wedge-shaped (broader than long), then triangular; the rays and division series and the lower brachials up to about the fifteenth are sharply flattened laterally, the arms then becoming strongly compressed laterally, and developing strongly overlapping distal edges to the brachials, which in a lateral view appear as overlapping spines. Syzygia occur between the third and fourth brachials, again about the sixteenth and seventeenth, and distally at intervals of 2 to 8 (usually 4) bifascial articulation.

The first pinnule is considerably longer and stouter than the following, which decrease in length to about the fifth, after which they gradually increase distally, but never become very long. The first pinnule is not excessively stout, as in *T. hawaiiensis*, but is more of the proportions of those of *T. orion* and *T. fisheri*.

*Color* (in spirits).—Brownish yellow, the distal half of the cirri lighter.

*Locality*.—Albatross Station No. 3963; Laysan Island Light bearing N. 56° 30' E., 6.6 miles distant; 319 fathoms; white sand and broken shell.

Two specimens.

*Type*.—Cat. No. 22690, U.S.N.M.

*Remarks*.—The presence of palmars and the slender cirri with only 40 joints distinguish this species at once from the preceding.

#### CHARITOMETRA LATERALIS, new species.

Centro-dorsal very thick, discoidal or almost columnar, more rarely truncated conical, bearing about 30 closely crowded cirri.

Cirri 30 mm. to 40 mm. long, stout, with 16 to 19 (rarely as few as 15 or as many as 21) joints, the first about half as long as broad, the second almost as long as broad, the third rather longer than broad, the remainder about half again as long as broad; the last 4 or 5 joints have the median part of the distal dorsal edge rather prominent, and the penultimate bears a small opposing spine.

Rays and usually all of the first costals concealed by the centro-dorsal; costal axillary low and broad, nearly three times as broad as long. Ten arms 160 mm. to 180 mm. long; first two brachials very short, about four times as wide as long, oblong; the costal axillaries

and first three brachials have produced, thin, and everted lateral edges, those of adjacent joints in close apposition and flattened against each other, very crenulate anterior and posterior edges, often dovetailing more or less, and rounded median ridges; the following 5 or 6 brachials are alternatingly tubercular, this feature being more or less pronounced, and sometimes almost obsolete in the smaller specimens; the fourth to about the twelfth brachials are wedge-shaped, broader than long, then becoming triangular and as long as wide, this continuing almost to the tip of the arm; the terminal brachials are quadrate, and finally elongate. Syzygia occur between the third and fourth brachials, again at about between the fifteenth and sixteenth, and distally at intervals of from 5 to 11 (usually 5 to 7) bifacial articulations. The brachials are, all but those at the base of the arms, rather strongly overlapping with finely serrate edges; the costals and lower 6 or 7 brachials are very sharply "wall-sided" and flattened against each other; the lower 10 to 15 brachials have more or less developed thin lateral flange-like processes, most developed in the posterior part; the lower brachials also have single small rounded tubercles developed on alternate sides of the median line, which may persist almost throughout the length of the arm.

The first two pinnules are somewhat longer, and more slender than their successors, and are composed of a greater number of smaller joints; the following pinnules are very stout in the basal half, then taper to a slender tip, the expansion of the basal joints gradually becoming less and less marked distally.

*Color* (in life).—Arms ochre yellow; cirri clear lemon yellow (Fisher). The containing alcohol is stained either a deep orange-red or emerald green.

*Localities*.—*Albatross Station No. 4177*: Kawahioa Point bearing S. 54° W., 17.5 miles distant (off Niilau): 451–319 fathoms; gray sand and globigerinae.

One specimen.

*Station No. 4179*.—Kawahioa Point bearing S. 60° 45' W., 19.2 miles distant (same locality): 378–426 fathoms; coarse sand, rocks, and pebbles.

Six specimens.

*Type*.—Cat. No. 22688, U.S.N.M., from this station.

*Station No. 4180*.—Kawahioa Point bearing S. 58° W., 19.5 miles distant (same locality): 426–417 fathoms; pebbles, globigerinae, and rocks.

Two young specimens, arms 25 mm. and 80 mm. long.

*Remarks*.—In the specimen with arms 80 mm. long both costals are visible, and the ends of the basal rays are prominent as vertically elongate tubercles in the angles of the calyx; the very broad character of the costals and lower brachials is very marked, as in the eversion

of their edges, especially the lateral edges; but the proximal and distal edges as yet have not taken on the characteristic crenulate character of those of the adults. The basal broadening of the arms of this species reminds one of the same character seen in the arms of *Rhizocrinus*. This specimen is peculiar in having on one ray a regenerating pair of arms in the place of a single arm lost, the distichals being 2, thus making 11 arms in all; no specimen with more than 10 arms has heretofore been observed in this group of the genus.

The smallest specimen has the entire radials visible; these have a pronounced rounded median ridge; the ends of the basal rays are prominent, and project rather more than in the preceding specimen. The broadness of the costals and lower brachials is marked, even at this early stage, though the succeeding brachials are much elongated; the eversion of the lateral edges of the costals and lower brachials is already apparent.

*Charitometra lateralis* belongs to the same division of the genus as *C. tuberosa* from the Philippines and *C. lata* from Japan; it differs from both in its larger size, much longer cirrus joints, which are about half again as long as wide instead of squarish, and the prominent eversion of the lateral edges of the costals and lower brachials, and the absence of the dorsal carination of the lower part of the arms, which is so characteristic a feature of *C. tuberosa*.

#### DISTRIBUTION OF THE SPECIES BY STATIONS.

- Station No. 3475.*—Kaiwi channel; 351 fathoms.  
*Thalassometra hawaiiensis.*
- Station No. 3476.*—Kaiwi channel; 298 fathoms.  
*Thalassometra hawaiiensis.*
- Station No. 3859.*—Between Molokai and Maui; 138–140 fathoms.  
*Trichometra vexator.*
- Station No. 3865.*—(Same locality); 256–283 fathoms.  
*Trichometra vexator.*
- Station No. 3882.*—(Same locality); 136 fathoms.  
*Thalassometra crassicirra.*
- Station No. 3883.*—(Same locality); 277–284 fathoms.  
*Trichometra vexator.*
- Station No. 3887.*—North coast of Molokai; 552–809 fathoms.  
*Atelecrinus conifer.*
- Station No. 3910.*—South coast of Oahu; 311–337 fathoms.  
*Trichometra vexator.*
- Station No. 3925.*—(Same locality); 323–299 fathoms.  
*Trichometra vexator.*
- Station No. 3938.*—Off Laysan Island; 148–163 fathoms.  
*Iridometra crispa.*

- Station No. 3963.—(Same locality); 319 fathoms.  
*Thalassometra delicata.*
- Station No. 3985.—Off Kauai; 477–430 fathoms.  
*Thalassometra gigantea.*
- Station No. 3992.—(Same locality); 400–500 fathoms.  
*Psathyrometra congesta.*
- Station No. 4107.—Kaiwi channel; 314–355 fathoms.  
*Trichometra rexator.*
- Station No. 4107.—Kaiwi channel; 350–355 fathoms.  
*Thalassometra crassicirra.*
- Station No. 4122.—Southwest coast of Oahu; 192–352 fathoms.  
*Thalassometra fisheri.*  
*Zenometra triserialis.*
- Station No. 4157.—Vicinity of Moko Manu; 762–1,000 fathoms.  
*Decametrocrinus rugosus.*
- Station No. 4177.—Off Niihau; 451–319 fathoms.  
*Charitometra lateralis.*
- Station No. 4179.—Off Niihau; 378–426 fathoms.  
*Charitometra lateralis.*
- Station No. 4180.—Off Niihau; 426–417 fathoms.  
*Charitometra lateralis.*

DESCRIPTIONS OF NEW SPECIES REFERRED TO, AND SOME  
ADDITIONAL SPECIES FROM THE PACIFIC OCEAN.

TRICHOMETRA ASPERA, new species.

Centro-dorsal hemispherical or rounded-conical, nearly covered with cirrus sockets.

Forty to 60 cirri 15 mm. long, with 25 to 30 joints; first joint short; second joint about as long as broad; third to eighth joints about twice as long as the proximal diameter; these joints are rather strongly "dice-box shaped," with flaring and overlapping distal ends, which are especially prominent in the median dorsal part, though they can scarcely be called spinous; following joints increasing in diameter from the proximal to the distal end, where they overlap somewhat, and gradually decreasing in length, from the twelfth onward being about as long as broad; while the distal dorsal border is somewhat prominent, it can never be considered a true spine; opposing spine arising from the entire dorsal surface of the penultimate joint, situated at its distal end, its length rather less than the diameter of the joint; terminal claw usually rather longer than the penultimate joint, moderately stout, and comparatively slightly curved. There are usually a few small cirri situated near the pole which may be less than half as long as the "long mature" cirri, and have 10, or 12 very slender and much elongated joints, with greatly expanded articulations.

Distal edges of radials even with the edge of the centro-dorsal, and very slightly curved, not extending up into the angles of the calyx interradially; first costals very short (six or eight times as broad as long) and bandlike, with a rounded notch in the distal median line; costal axillaries rhombic, about half again as broad as long, with a rounded posterior projection incising the first costals; the anterior sides are moderately concave, but the anterior angle is not especially long; costals and two lowest brachials in close apposition and laterally flattened. Ten arms 45 mm. to 60 mm. long (usually about 50 mm. to 55 mm.); first brachial very short, much longer outwardly than inwardly, and almost bisected by a backward prolongation from the second brachial, which is irregular in shape and considerably larger; third and fourth brachials (syzygial pair) about half again as broad as long, rather longer on the inner than the outer side; following brachials to the eleventh wedge-shaped, much broader than long, with the anterior and posterior ends strongly concave; following brachials becoming more obliquely wedge-shaped, after the sixteenth or seventeenth triangular, as long as, or rather longer than, wide, after the proximal third of the arm becoming wedge-shaped again and more elongate, somewhat "dice-box shaped," and distally still more elongate, less and less obliquely quadrate, and more and more "dice-box shaped." Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of two (more rarely three) bifascial articulations. The lower brachials have the distal edges strongly and prominently everted and spinous, standing out vertically from the axis of the arm, giving it a characteristic scalloped dorsal outline; this condition, however, dies away after about the sixteenth brachial, the distal edges of the joints becoming almost smooth, although they may be seen, under a strong glass, to bear a fringe of short, fine spines.

First pinnule 6 mm. long with 20 to 25 joints, very slender, the first 3 or 4 joints about as long as broad, the remainder becoming progressively elongated and exceedingly long and slender distally; after the fourth or fifth joint the distal ends become greatly expanded and widely flaring, overlapping the bases of the succeeding joints; this flaring of the distal ends is confined to the distal ends of the joints, arising rather suddenly; the distal end of a joint is usually about twice the diameter of the remainder; the pinnule of the first syzygial pair (first inner pinnule) may be similar or it may be twice as long as the first pinnule; the second pinnule is 4 mm. long, considerably stouter than the first, tapering evenly from the base to the tip, with 10 joints, the first 3 squarish, the remainder becoming progressively elongated; the distal ends of the joints are not especially prominent; third pinnule about the same length, but rather stouter (especially

distally) and much stiffer, with 10 joints, the first not so long as wide, the second and third squarish, the following becoming progressively elongated; the fourth, fifth, sixth, and proximal half of the seventh bear a large genital gland; following pinnules to the seventh or eighth similar, but gradually becoming longer and stouter; after the ninth the pinnules develop somewhat "dice-box shaped" joints with prominent distal ends, contrasting more or less with the smoother genital pinnules; the distal pinnules are 6 mm. long, the first joint short and wedge-shaped, the second about as long as wide, slightly trapezoidal, the remainder much elongated with prominent articulations and protruding distal ends.

*Type*.—Cat. No. 22678, U.S.N.M.; from *Albatross* Station No. 2666; off southern Georgia; 270 fathoms.

THAUMATOMETRA PARVA, new species.

Centro-dorsal rather small, hemispherical or low-conical, the cirrus sockets closely set in two or three crowded rows, leaving only a small portion of the dorsal pole bare.

Cirri about 30 in number, 9 mm. long, with 10 to 12 joints; first joint squarish, second about half again as long as broad, third and fourth between three and four times as long as broad, following joints gradually decreasing in length, and gradually becoming broader dorso-ventrally and laterally compressed; the antepenultimate joint is oblong, about twice as long as broad, and the penultimate is about half again as long as broad and bears on its anterior dorsal edge a small opposing spine less than one-third of its transverse diameter in length, which is directed obliquely forward; the terminal claw is about the length of the penultimate joint, rather stout, and moderately curved; the second to the fifth joints have expanded ends, but these die away as the joints become compressed.

Radials even with the edge of the centro-dorsal; first costals short, oblong, about four times as broad as long, somewhat narrower anteriorly than posteriorly, rounded, and well-separated laterally; costal axillaries rhombic, somewhat broader than long, the anterior sides somewhat curved and the anterior angle rather sharp, with a rounded backward projection rising to a slight tubercle. Ten arms, apparently about 30 mm. long; first brachial wedge-shaped, the outer sides longer than the inner, entirely free interiorly; second brachial much larger, irregularly quadrate; third and fourth (syzygial pair) somewhat longer than broad, and slightly longer interiorly than exteriorly; fifth to eighth brachials oblong, about half again as broad as long, the joints then becoming wedge-shaped and about as long as broad; only the basal third of the arms is present. Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials.

First pinnule 6 mm. long, very slender, with 15 joints, the first very short, the second and third about as long as broad, with their corners cut away, the fourth and fifth about half again as long as broad and more slender than the preceding, and the remainder becoming rapidly elongated with swollen articulations, and very slender and filiform; second pinnule very slightly shorter, the first joint short, the second squarish, the third about half as long again as wide, and the remainder becoming progressively elongated; this pinnule is about as stout basally as the first, but does not taper so rapidly, so that the general appearance is considerably stouter; a large genital gland is present, occupying from the fourth to the eleventh joints; following pinnules, so far as they remain, similar to the second.

*Color* (in spirits).—White, the perisome darker.

*Type*.—Cat. No. 22694, U.S.N.M.; from *Albatross* Station No. 3697; Sagami Bay, Japan; 120 to 265 fathoms.

THAUMATOMETRA COMASTER, new species.

Centro-dorsal low-hemispherical, nearly covered with cirrus-sockets which are closely crowded together and more or less irregularly placed.

Forty to 45 cirri, 8 mm. long (the "small mature" cirri being rather shorter), with 13 to 17 (usually about 15) joints; first joint short, second about as long as broad, third over twice as long as its proximal diameter, and the fourth, which is the longest, about three times as long as its proximal diameter; the following joints gradually decrease in length, the 4 or 5 terminal joints being about half again as long as broad; opposing spine very small, terminally situated, and directed obliquely forward; terminal claw about as long as the penultimate joint, rather stout and well curved; the lower joints have flaring and expanded ends, this character dying away on the terminal 5 or 6, which are somewhat compressed laterally.

Radials even with the edge of the centro-dorsal; first costals very short, with straight lateral edges, concave anteriorly; costal axillaries rhombic, about as long as broad, the anterior angle somewhat produced, the posterior projection incising the first costal rather sharp. Ten arms about 45 mm. long; first brachial short, about twice as long exteriorly as interiorly, concave anteriorly, the inner edges entirely free; second brachial larger, irregular, with an angular posterior projection incising the first brachial; third and fourth brachials (syzygial pair) about as long as broad, slightly longer interiorly than exteriorly; following 4 or 5 joints oblong or slightly wedge-shaped, broader than long, then becoming more obliquely wedge-shaped and rather longer than broad, gradually increasing in length distally. Syzygia occur between the third and fourth, ninth and



tenth, and fourteenth and fifteenth brachials, and distally at intervals of three bifascial articulations.

The pinnules appear to be similar to those of *T. isis*, but the genital gland on the second is much larger, and occupies the fourth to the eleventh joints.

*Color*.—Grayish brown, the skeleton dull white.

*Type*.—Cat. No. 22681, U.S.N.M.; from *Albatross* Station No. 5032; in Yezo Strait; 300 to 533 fathoms.

BATHYMETRA MINUTISSIMA, new species.

Centro-dorsal rather small, hemispherical, the dorsal pole furnished with several rather long spines; the cirrus sockets arranged in 3 crowded columns of usually 3 each in each radial area.

Cirri about 45 in number, 4 mm. long, with 12 to 15 joints; first joint rather less than half as long as wide; second joint over twice as long as its proximal diameter, flaring rapidly from about the middle so that the diameter of the distal end is nearly twice that of the proximal; third and following joints very slender and greatly elongated, expanding in each direction, but especially distally, into large flaring ends; fourth joint similar; the following joints gradually decrease in length, the proximal ends becoming less and less enlarged, but the distal ends remain enlarged and funnel shaped; antepenultimate joint over three times as long as its proximal diameter, expanding from the base to the tip, but more rapidly in the outer two-thirds; penultimate about twice as long as broad, with a long triangular opposing spine arising from the whole of the dorsal surface, and nearly as long as the distal diameter of this joint; its distal edge is perpendicular to the long axis of the joint; terminal claw moderately slender, curved, about equal to the penultimate joint in length.

Radials rather short in the median line, but strongly produced interradially, the anterior border being very strongly concave; the anterior interradiial projections do not separate the first costals, which are very short, the lateral edge, which is about twice as long as the length in the median line, being not much more than one-third of the width; the distal border is broadly fringed with fine spines, and the dorsal surface is finely granulose; costal axillaries rhombic, broader than long, the edges, especially the anterior, strongly concave; the dorsal surface is finely granulose, and fine spines are developed laterally; costals and first two brachials on the outside, and first three on the inside, in close apposition and flattened laterally, with very finely spinous lateral borders. Ten arms 13 mm. long; first brachial short, the outer edge rather longer than the inner, strongly concave anteriorly, the anterior border with a strong fringe

of very fine spines, the dorsal surface granulose; second brachial irregular in shape, with a strong rounded posterior projection; third and fourth brachials (syzygial pair) about half again as long as broad; following joints rather longer than broad, gradually becoming more elongate, in the outer part of the arm reaching a length of about three times their width; the brachials are all remarkable for their strongly concave surface, which makes them all strongly "dice-box shaped" with large and expanded ends, which, from the sixth brachial onward, bear a fringe of rather large spines. Syzygia occur between the third and fourth brachials, again between the ninth and tenth and fourteenth and fifteenth, and distally at intervals of two bifascial articulations (i. e., "in alternate joints").

First pinnule very slender and filiform; first 3 joints about as long as broad, strongly concave dorsally with prominent ends, then becoming rapidly elongated with broadly flaring distal ends; the tip of the pinnule is broken; the third and following pinnules bear on the fifth to the seventh joints (which are slender and much elongated) large genital glands; the distal pinnules are exceedingly slender, the first joint nearly as long as broad, the second about twice as long as broad, wider proximally than distally, the remainder very slender and greatly elongated, with expanded ends.

*Bathymetra minutissima* is scarcely half the size of the other three species of the genus, from all of which the presence of broad spinous borders on the costals and the prominent spinous overlaps of the brachials at once distinguish it.

*Type*.—Cat. No. 22671, U.S.N.M.; from *Albatross* Station No. 2761, east of the Abrolhos Islands, off the Brazilian coast; 818 fathoms.

BATHYMETRA BREVICIRRA, new species.

Centro-dorsal hemispherical, rather low, bearing about 45 cirrus sockets in 3 crowded columns of 3 each in each radial area.

Cirri 30 to 40, 6 mm. long, with 14 joints; first joint rather less than half as long as broad, second joint rather longer than broad, sometimes squarish, third joint rather more than twice as long as its proximal diameter, centrally constricted with expanded ends, fourth joint about three times as long as its proximal diameter, also strongly "dice-box shaped;" following joints decreasing gradually in length, the proximal ends becoming less, and the distal rather more expanded, the antepenultimate joint being about twice as long as the diameter of its proximal end, the penultimate rather shorter, with an opposing spine which is not so long as the diameter of the joint, arising from its distal half; terminal claw short, conical, slightly curved, from one-half to three-quarters the length of the penultimate joint.

Radials short, strongly concave anteriorly, and produced in the interradial angles of the calyx, but not separating the first costals;

first costals short, concave anteriorly, but with a straight posterior border, over twice as broad as its lateral and over three times as broad as its median length; costal axillaries practically square, the sides very little curved; costals and first two brachials flattened laterally and in close apposition. Ten arms about 25 mm. long; first brachial short, longer outwardly than inwardly, the anterior edge concave; second brachial about twice as large, irregularly quadrate; third and fourth brachials (syzygial pair) somewhat longer than broad, the epizygial oblong, the hypozygial wedge-shaped or almost triangular, the longer side in; following brachials squarish, after the ninth becoming wedge-shaped, longer than wide, and more elongate distally; all the brachials have a more or less concave surface, this becoming more marked after the ninth, when the distal edges begin to project somewhat. Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of three or four bifascial articulations.

First pinnule long, filiform, with 11 joints, the first 2 squarish, then becoming rapidly elongate, the distal being exceedingly long and slender; the distal pinnules have the first joint wedge-shaped or almost crescentic, broader than long, the second wedge-shaped, longer than broad, and the following becoming progressively elongated.

The comparatively short cirrus joints of this species, especially the second, which is hardly more than squarish, distinguish this species at once from the others in which the cirri are known; the large number of cirri and the comparative shortness of the interradial processes of the radials differentiate it at once from *Bathymetra carpenteri*.

*Type*.—Cat. No. 22672, U.S.N.M.; from Albatross Station No. 4766; western Bering Sea; 1766 fathoms.

BATHYMETRA CARPENTERI, new species.

1888. *Antedon abyssicola* P. H. CARPENTER, *Challenger Reports*, XXVI, Zoology, pl. XXXIII, fig. 2 (not fig. 1), and p. 191 (part).

The name *carpenteri* is here conferred upon the form obtained by the *Challenger* west of Tasmania, and referred to *abyssicola* by Doctor Carpenter. The difference between the two forms is so very considerable that it does not seem desirable to include them both under the same specific name, at any rate until intergradation shall have been proven. In *Bathymetra carpenteri* the centro-dorsal is low, subconical, about half as high as broad, the cirrus sockets distributed about its margin, and the outline of the calyx and lower part of the arms is rounded, much as in *Antedon* or *Heliometra*, whereas in *B. abyssicola* the centro-dorsal is about as long as wide, bearing cirri only about the dorsal pole, the basal half or more of the centro-dorsal being smooth, and the calyx is long and slender, with a small angle of divergence, as in *Charitometra incisa* or *C. basicurea*.

It gives me pleasure to be able to associate with this species the name of the foremost worker on the unstalked crinoids, the late Dr. P. Herbert Carpenter.

ADELOMETRA TENUIPES, new species.

Ten arms; centro-dorsal conical, about once and one-half as long as broad, the sides rather slightly convex, bearing 10 columns of cirrus sockets, close together, the sockets of one column alternating with the sockets of those adjacent; the columns are definitely marked, each consisting of about 4 sockets.

Cirri about 30, 13 mm. to 18 mm. long, with 30 to 35 joints; first joint short; second about as long as wide, third joint twice as long as its distal diameter; fourth to tenth joints about three times as long as the distal diameter, then gradually diminishing in length, the sixteenth and seventeenth and remaining joints being about as long as wide; the elongate proximal joints have expanded and funnel-shaped distal ends, dorsally somewhat produced anteriorly, sometimes forming a small spine, this feature becoming less marked as the joints become shorter; the fourteenth joint bears distally a sharp dorsal spine, which on the following joints progressively occupies more and more of the dorsal surface, after 4 or 5 joints arising from the entire dorsal surface; as the dorsal spines increase in extent, the ventral overlap decreases, so that ventrally the terminal joints are perfectly smooth; the opposing spine is an equilateral triangle not quite so high as the width of the penultimate joint, the apex situated slightly beyond the center of the dorsal surface; terminal claw about the length of the penultimate joint, stout, and moderately curved.

Except in the characters of the centro-dorsal and cirri, as detailed above, this species closely resembles *A. angustiradia*, discovered by the *Challenger* in the Ki Islands, and described from a specimen in practically the same condition as the type of *A. tenuipes*.

*Type*.—Cat. No. 22677, U.S.N.M.; from *Albatross* Station No. 2348; off Habana, Cuba; 211 fathoms.

PSATHYROMETRA BOREALIS, new species.

Centro-dorsal long-conical, 6 mm. long by 5 mm. broad, separated into five radial areas by interradial lines which are as wide as, or slightly wider than, the columns of cirrus sockets, and are continued to the tip of the centro-dorsal; cirrus sockets in 3 columns in each radial area, 7 to 9 to a column, separated from each other by narrow lines. In general form and build this is the most slender and delicate species of the genus.

*Type*.—Cat. No. 22670, U.S.N.M.; from *Albatross* Station No. 4780; east of Agattu Island, Aleutians; 1,046 fathoms.

## PSATHYROMETRA PROFUNDORUM, new species.

Centro-dorsal conical, rather long, 7 mm. long by 4.5 mm. wide, divided into radial areas by interradiial lines, proximally about half as broad as the cirrus sockets, gradually becoming narrow and obsolete distally; 3 columns of cirrus sockets in each radial area, closely crowded together, with prominent edges, especially proximally, 6 cirrus sockets to a column. The calyx and lower part of the arm are rather more tuberculous than in the other known species.

*Type*.—Cat. No. 22669, U.S.N.M.; from *Albatross* Station No. 3342, off Moresby Island, Queen Charlotte group; 1,588 fathoms.

## ZENOMETRA PYRAMIDALIS, new species.

Centro-dorsal long-conical, about twice as long as its width at the proximal end, bearing 5 strong interradiial ridges, high proximally, becoming gradually lower and finally obsolete distally; cirrus sockets in 2 columns of about 6 each, separated by a more or less distinct ridge, in each radial area. In other respects this species is similar to *Z. columnaris*, but the spines on the calyx are somewhat more numerous and much longer. The pointed centro-dorsal of this species makes confusion with *Z. columnaris* impossible.

*Type*.—Cat. No. 22668, U.S.N.M.; from *Albatross* Station No. 2415, off Savannah, Georgia; 440 fathoms.

## HIMEROMETRA SUBCARINATA, new species.

Centro-dorsal thick discoidal, the large bare polar area strongly convex, bearing about 40 cirri in two irregular rows; cirri 22 mm. long with 33–35 segments, those in the basal half of the cirrus slightly longer than wide, those in the distal half gradually becoming short and bearing prominent dorsal spines; radials just visible in the angles of the calyx; first costals short and broad; axillaries short, broadly pentagonal or almost triangular; the rays, distichals, and first 2 brachials are in close apposition and are strongly flattened laterally; distichals 2, articulated; the costals, distichals, and first 2 brachials have a very narrow, delicate, raised median line, giving them a very characteristic appearance. Forty arms, 80 mm. long; first 2 brachials slightly wedge-shaped, following 6 discoidal about half as long as wide, then becoming quadrate, and almost triangular, soon becoming quadrate again, and almost oblong distally; the third and fourth brachials are united by syzygy; the next syzygial pair occurs at from the twentieth to the thirty-sixth (usually about the twenty-fifth); the distal intersyzygial interval is from 5 to 12 (usually about 7) brachials; first pinnule slender, stiffened, 7 mm. long, with 15 segments, the first 3 squarish and strongly carinate, the fourth

trapezoidal and somewhat carinate, the remainder elongated; second pinnule 11 mm. long, with 20 segments, the first 2 short and carinate, the others elongate, about two and a half times as long as broad; third and fourth pinnules similar and equal in length, 15 mm. long, with 18 to 20 segments, the first 2 as in the second, the others elongate, three or more times as long as broad; fifth pinnule 8 mm. long, most like the first; following pinnules 5 mm. long, small and weak, becoming slightly longer distally. The elongate lower pinnules are comparatively slender, but stiff and wiry.

*Type*.—Cat. No. 22666, U.S.N.M.; from *Albatross* Station No. 4880; Sea of Japan; 59 fathoms. August 2, 1906.

OLIGOMETRA CARIBBEA, new species.

Centro-dorsal thick-discoidal, with a rather large bare polar area, and bearing 2 irregular marginal rows of cirri.

Cirri about 20 in number, 5 mm. long, with 15 to 17 (usually 15 or 16) joints; first joint very short, second rather more than half as long as broad, the remainder squarish; the second and third joints bear on their distal edge a sharp dorsal spine, which after one or two joints moves to the middle of the dorsal edge; the opposing spine is rather less than the diameter of the penultimate joint in length, and stands out vertically from the middle of the dorsal side; terminal claw not quite so long as the penultimate joint, stout, and strongly curved.

Radials visible, but very short; first costals oblong, about twice as broad as long, slightly concave anteriorly, just in apposition laterally, but not laterally flattened; costal axillaries pentagonal, about as long as broad. Ten arms, probably about 25 mm. long; first brachial wedge-shaped, the longer side out and inwardly united for about the proximal two-thirds; second brachial larger, irregular in shape; following brachials squarish, gradually becoming wedge-shaped, more oblique after the twelfth, when they are about as long as wide. Syzygia occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and distally at intervals of three bifascial articulations.

First pinnule 5 mm. long, with 6 joints, the first short, but distally produced into a rounded projection, the second rather more than twice as long as wide, the remainder greatly elongated; second pinnule similar, equally stout basally, but not quite so long; third and following pinnules 3.5 mm. long, the first two joints short (the first somewhat broader than the second), the third, fourth, and fifth somewhat expanded laterally to protect the genital glands; the distal pinnules are lacking.

*Type*.—Cat. No. 22676, U.S.N.M.; from *Albatross* Station No. 2146; off Colon, Canal Zone; 34 fathoms.

## CYLLOMETRA ALBOPURPUREA, new species.

This species represents *C. manca* in the waters about southern Japan; it differs strikingly from that species in having all the cirrus joints subequal in length, the distal with only slight paired tubercles on the dorsal side. In *C. manca* the proximal cirrus joints are much elongated, the distal short, with long bi- or tri-dentate dorsal spines. The number of arms in *C. albopurpurea* varies from 10 to 30, but is most commonly about 20. The 10 armed forms differ from *C. tigrina* in being more slender, with the second pinnule more slender, and composed of much elongated instead of short joints.

*Type*.—Cat. No. 22693, U.S.N.M.; from Albatross Station No. 5095; Uraga Straits, entrance to Tokyo Gulf, Japan; 58 fathoms.